

**ARTIFICIAL INTELLIGENCE IN THE STUDY OF PHYSIOLOGICAL
PARAMETERS OF THE HUMAN RESPIRATORY SYSTEM**

Avezova Salomat Makhmudjonovna

Tashkent State Medical University

avezovasalomat75@gmail.com

Abstract

Modern artificial intelligence technologies offer new opportunities for analyzing physiological parameters of the human respiratory system. Machine learning algorithms enable processing large data sets, identifying patterns, and predicting lung function based on standard respiratory parameters. This study analyzed data from 60 volunteers across three age groups using an AI system to assess vital capacity, respiratory rate, and minute volume. Results showed that the AI system can accurately classify age-related respiratory function characteristics and identify functional decline in elderly participants. The use of AI can improve diagnostic accuracy, reduce analysis time, and improve the risk prediction of respiratory disorders.

Keywords

artificial intelligence, respiratory system, vital capacity, respiratory rate, minute volume, machine learning, physiological parameters.

Аннотация

Современные технологии искусственного интеллекта открывают новые возможности для анализа физиологических параметров дыхательной системы человека. Использование алгоритмов машинного обучения позволяет обрабатывать большие массивы данных, выявлять закономерности и прогнозировать функциональное состояние лёгких на основании стандартных показателей внешнего дыхания. В данном исследовании были проанализированы данные 60 добровольцев трех возрастных групп с использованием системы ИИ для оценки жизненной ёмкости лёгких, частоты дыхания и минутного объёма дыхания. Результаты показали, что ИИ способен точно классифицировать возрастные особенности дыхательной функции и выявлять снижение функциональных показателей у пожилых участников. Применение ИИ позволяет повысить точность диагностики, сократить время анализа и улучшить прогнозирование риска дыхательных нарушений.

Ключевые слова

искусственный интеллект, дыхательная система, жизненная ёмкость лёгких, частота дыхания, минутный объём дыхания, машинное обучение, физиологические параметры.

Introduction

The human respiratory system is key to maintaining homeostasis and providing the body with oxygen. Physiological respiratory parameters such as vital capacity, respiratory rate, and minute volume are used to assess lung function. Traditionally, measuring these parameters requires manual counting and analysis, which limits the accuracy and speed of data processing.

With the development of artificial intelligence technologies, it has become possible to automate the collection, processing, and interpretation of respiratory data. Machine learning algorithms can identify hidden patterns in physiological data and predict respiratory decline before clinical symptoms occur.

The use of AI is particularly relevant in studying age-related changes in respiratory function. With age, decreased lung elasticity, reduced respiratory muscle strength, and reduced respiratory volume are observed. Analyzing large data sets using AI allows for the extraction of quantitative indicators and the identification of individual respiratory characteristics across different age groups.

Study Objective

The aim of this study is to assess the functional state of the respiratory system in individuals of different age groups using artificial intelligence technologies and to identify age-related differences in physiological parameters.

The objectives of the study include collecting data on vital capacity, respiratory rate, and minute volume in volunteers, using AI algorithms to analyze and classify the data, and comparing respiratory function parameters across age groups.

Research Materials and Methods

Sixty volunteers, divided into three age groups, participated in the study. The first group included children and adolescents aged 10–15 years; 20 participants included 12 boys and 8 girls. The second group consisted of adults aged 20–40 years (20 participants, 10 men and 10 women). The third group included elderly individuals aged 60–70 years (20 participants, 9 men and 11 women).

All participants were healthy, had a body mass index between 18 and 25 kg/m², and engaged in physical activity at least twice a week. Each participant signed a consent form to participate in the study.

To assess respiratory function, vital capacity, respiratory rate, and minute volume were measured. Vital capacity was measured using a portable spirometer. Each participant performed three series of measurements, including a maximal inhalation and a full exhalation into the device. Tidal volume was set to 0.4 liters for children and 0.5 liters for adolescents and adults. The results of the three series were averaged to obtain an accurate vital capacity value.

Respiratory rate was recorded at rest, in a sitting position, and counted for one minute. The average respiratory rate was determined as the arithmetic mean of the three measurements.

All data was recorded in an electronic database and processed using machine learning-based artificial intelligence algorithms. Random Forest models and neural networks were used to classify participants into age groups, identify patterns in physiological parameters, and predict declines in respiratory function. AI algorithms were used to identify individual deviations from normal values and assess the accuracy of participant classification.

Statistical data processing included testing the significance of differences between age groups using a t-test for independent samples at a significance level of $p < 0.05$. The results of the AI processing were evaluated based on classification accuracy, recall, and prediction precision.

All measurements were taken in the morning at rest at an air temperature of 22–24°C and humidity of 50–60%. Each participant completed three sets of measurements, and the results were averaged, providing accurate indicators of respiratory function for each age group.

Methods

The study utilized spirometry to measure vital capacity, calculate resting respiratory rate, calculate minute respiratory volume, and analyze data using machine learning algorithms. Data were classified by age group, and a prediction of decline in respiratory function was made. Statistical analysis included testing for significance of differences using a t-test at a significance level of $p < 0.05$.

Study Results

The average respiratory function parameters across the three age groups were as follows.

Children and adolescents 10–15 years old: vital capacity 2.1 ± 0.3 L, respiratory rate 21 ± 2 breaths/min, minute respiratory volume 8.4 ± 1.2 L/min. Adults 20–40 years old: vital capacity 4.1 ± 0.4 L, respiratory rate 16 ± 2 breaths/min, minute ventilatory volume 8.0 ± 1.0 L/min.

Elderly 60–70 years old: vital capacity 2.8 ± 0.3 L, respiratory rate 18 ± 2 breaths/min, minute ventilatory volume 5.0 ± 0.7 L/min.

The use of AI algorithms enabled the classification of participants by age group with 92% accuracy, identification of decreased functional activity in elderly participants, and identification of individual deviations in three patients.

A comparative analysis showed that the vital capacity of adults is 95% higher than that of children and 46% higher than that of the elderly. Respiratory rate is 31% higher in children than in adults, and 12% higher in the elderly. Minute respiratory volume in the elderly is 37% lower than in adults.

Discussion

Children have a higher respiratory rate and lower vital capacity due to the immaturity of their respiratory system. Adults demonstrate maximum functional performance. In the elderly, vital capacity and minute respiratory volume are reduced due to decreased lung elasticity and weakened respiratory muscles.

The use of artificial intelligence allowed us to automate data processing, identify patterns, and predict declines in respiratory function. The accuracy of age group classification was 92%, confirming the effectiveness of AI in assessing respiratory function. The use of AI reduces data analysis time and improves the objectivity of lung assessment.

Conclusion

The functional state of the respiratory system varies with age.

Children aged 10–15 years have a vital capacity of 2.1 ± 0.3 L, a respiratory rate of 21 ± 2 breaths/min, and a minute volume of 8.4 ± 1.2 L/min.

Adults aged 20–40 years have a vital capacity of 4.1 ± 0.4 L, a respiratory rate of 16 ± 2 breaths/min, and a minute volume of 8.0 ± 1.0 L/min. Elderly people aged 60–70 years have a vital capacity of 2.8 ± 0.3 l, a respiratory rate of 18 ± 2 breaths/min and a minute respiratory volume of 5.0 ± 0.7 l/min.

The use of AI enabled the classification of participants with 92% accuracy, identification of functional decline in elderly participants, and identification of individual deviations. Artificial intelligence is an effective tool for analyzing physiological parameters of the respiratory system, predicting age-related changes, and improving diagnostic accuracy.

References:

1. Гайворонский И.В. Анатомия и физиология человека. Москва: Академия, 2018.
2. Hall J.E. Guyton and Hall Textbook of Medical Physiology. Philadelphia: Elsevier, 2020.
3. West J.B. Respiratory Physiology: The Essentials. Philadelphia: Lippincott Williams & Wilkins, 2018.
4. Topol E.J. Deep Medicine: How Artificial Intelligence Can Make Healthcare Human Again. New York: Basic Books, 2019.
5. Esteva A., Robicquet A., Ramsundar B. et al. A guide to deep learning in healthcare. Nat Med, 2019; 25: 24–29.
6. Smirnov V.M. Физиология дыхания. Санкт-Петербург: 2025.